

ABSTRACT

A method of producing hot rolled steel having improved formability and minimal silver formation comprises the addition of Titanium and Boron to the molten steel to combine with and remove the free nitrogen prior to rolling. Titanium is added so that the amount of nitrogen remaining after Ti addition is about 0.0005 wt% to about 0.0025 wt% and Boron is added to remove the balance of the nitrogen by forming BN.

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Processing	Grade Type	LCAK	LCAK + Ti	LCAK + Ti	LCAK + Ti	LCAK + B	LCAK + Ti/B	Min / Max
	Grade	CC040	CC040B	CC041	CC846EX	CC040F		
	Coiling Temperature	650	650	650	650	650	650	
	Tension Leveling Elongation	1%	1%	1%	0.5% & 1.0%	0.5% & 1.0%	0.5% & 1.0%	
Chemistry	C	0.041 ± 0.003	0.041 ± 0.004	0.041 ± 0.004	0.045 ± 0.002	0.042 ± 0.005		
	N	0.0057 ± 0.0008	0.0038 ± 0.0007	0.0037 ± 0.0008	0.0044 ± 0.0003	0.0033 ± 0.0007		
	B	0	0	0	0.0037 ± 0.0003	0.0018 ± 0.0002		
	Ti	0.0012 ± 0.0005	0.018 ± 0.003	0.014 ± 0.003	0.0015 ± 0.0003	0.0058 ± 0.0020		
	N*	0.0054 ± 0.0007	0	0	0.0039 ± 0.0004	0.0016 ± 0.0007	-0.0002 / 0.0035	
	BxN*	0	0	0	0.146E-5 ± 0.24E-5	2.85 E-6 ± 1.27E-6	-0.5E-6 / 6.4 E-6	
	Stabilization Ratio	0.085 ± 0.029	1.41 ± 0.31	1.12 ± 0.23	1.21 ± 0.09	1.28 ± 0.30	0.7 / 2.4	
	Orientation							
	Count	66	776	62	116	739	575	
Yield Strength	Avg	36.8	34.2	34.9	30.1	31.5	33.1	
	Std Dev	2.0	1.9	1.4	1.5	1.9	1.9	
	Min	32.8	28.1	31.0	26.2	26.4	28.4	
	Max	42.2	43.0	38.2	34.2	39.9	43.1	
Tensile Strength	Avg	52.2	50.1	50.4	48.2	48.2	48.3	
	Std Dev	1.4	1.3	0.9	1.1	1.4	1.4	
	Min	49.4	46.6	47.8	44.9	43.3	37.0	
	Max	57.0	61.1	53.0	50.9	52.5	53.9	
Total Elongation	Avg	40.8	43.2	43.1	43.7	43.5	41.5	
	Std Dev	2.7	2.7	2.5	2.6	2.5	2.9	
	Min	30.0	24.8	34.8	36.2	29.1	27.4	
	Max	46.5	50.8	48.0	50.6	53.2	50.3	
n value	Avg	0.198	0.208	0.206	0.208	0.201	0.200	
	Std Dev	0.013	0.010	0.009	0.009	0.012	0.009	
	Min	0.165	0.160	0.186	0.180	0.165	0.168	
	Max	0.230	0.243	0.226	0.225	0.263	0.223	
Sliver Frequency	Average	0.0	0.0	0.0	41.9	0.9		
	Std Dev	0	0	0	28.2	2.2		